Title: Opportunity cost of unavailable surgical instruments in Australian hospitals

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Hospitals invest considerable resources organising operating suites and having surgeons and theatre staff available on an agreed schedule. A common impediment to efficiency is perioperative delay, including delays getting to the operating room or during the operation. Perioperative delays entail significant costs for hospitals, wasting staff time and operating theatre resources. They may also affect patient outcomes; prolonged surgery is a predictor for unanticipated admission following elective ambulatory surgery.

A common cause of perioperative delay is a lack of availability of surgical instruments.[1] Because procuring a new item takes time, a lack of availability can both delay commencement, and prolong duration, of surgery. However, the occurrence of unavailable instruments, and the impact of this problem, has not previously been quantified in an Australian hospital. We undertook a survey of all surgeries undertaken in 22 operating theatres of a general tertiary referral teaching hospital between 12 May and 8 June 2008 to estimate the occurrence of unavailable instruments and quantify the impact on surgical schedules and resource utilization.

A total of 1,896 surgeries were surveyed, of which 235 (12%) had instruments unavailable for the surgery. The proportion of surgeries with unavailable instruments varied between specialty, with the highest percentage (18%) observed in obstetrics and gynaecology. Of surgeries reporting missing instruments, one fifth needed to open an additional surgical tray in order to source a replacement instrument. Consequently, an estimated 550 additional instrument trays are opened annually in this facility in order to source missing instruments.

A total of 34 surgeries experiencing missing instruments (14%) also experienced delays at either the start of or during the operation due to this problem. Start times for surgeries were reported as delayed in 7% of cases for an average of 13 minutes. Additionally,

procedure times were delayed in 8% of surgeries by an average of 11 minutes. This equates to an estimated loss of 84 hours of operating theatre time annually in this facility; equivalent to the duration of approximately 47 elective total knee replacement surgeries.

No surgeries from any specialty were cancelled directly because of a lack of available instruments. However, the knock-on effect of perioperative delays caused by unavailability of instruments is likely to contribute indirectly to this problem as surgeries scheduled later in the day face cancellation. This is consistent with an earlier Australian study[2] of surgical cancellations that found only 1% were directly due to lack of equipment but 19% of cancellations resulted from a lack of theatre time due to over-run of earlier surgeries.

Results of an earlier stakeholder survey found that the problem of unavailable instruments is seen across the State's public hospitals.[3] As such we extrapolated our survey findings to estimate the annual economic cost of unavailable instruments to Queensland Health from the perspective of the healthcare provider. We obtained data on the total number of surgeries undertaken in Queensland public hospitals in 2010, and used probabilities from the survey to estimate the annual incidence of missing instruments, number of additional trays opened to provide replacements, and the total time lost to perioperative delays in each specialty. Assuming that the same pattern of instrument availability is seen across facilities, over a twelve month period we would expect nearly 19,000 surgeries in Queensland public hospitals to experience unavailable instruments. This would require opening (and thus sterilising) of over 3,500 extra instrument trays and result in over 1300 delayed surgeries and more than 1500 prolonged surgeries annually. This represents extra sterilising costs of over $183,000 (at $50 per tray),[3] and lost operating theatre capacity of more than 584 hours annually. It must be recognised though, that if patterns of instrument availability differ significantly across facilities, this may either under- or overestimate the Statewide burden.

The opportunity costs associated with unavailable instruments extend across the instrument usage and processing life cycle. The opening of additional instrument trays places an increased operational burden on the sterilising department. The time of surgical and operating theatre personnel lost to perioperative delays could be used for other purposes, such as extra- or postoperative patient care, teaching and research, or other aspects of overall operating room function. Cases that extend after regular hours due to earlier delays may incur staff overtime costs, and potentially surgeries may be cancelled at the end of the day.[2] Finally, perioperative delays contribute to negative physical patient outcomes associated with prolonged surgeries, the psychological costs of delays experienced by patients, families, surgeons and anaesthetists, and lower levels of patient satisfaction with their hospital experience.[4]

In 2010-11, the Australian Institute of Health and Welfare reported that Queensland public patients faced a median wait time to admission for elective total knee replacement surgery of 109 days and 7.7% of patients waited longer than a year. Recently, financial penalties have been introduced for facilities with extended wait times. There is clearly scope to improve overall efficiency in the surgical system and to reduce the time patients spend on waiting lists. Investing in strategies to improve instrument availability may help to avoid the variety of opportunity costs discussed here; potentially justifying investment in this area even if, in the short term, operational constraints prevent immediate increases in the number of surgeries performed. Longer term, research into efficient design of operating theatres and sterilising departments, indicates that strategies to improve instrument availability (including use of electronic tracking systems, staff education and training, and perioperative and sterilising process redesign) are able to successfully translate into improved operating theatre throughput and efficiency.[4]

There is potential for economic benefits if effective programs to reduce the occurrence of unavailable instruments are implemented in Australian hospitals, thereby avoiding the perioperative delays and other opportunity costs associated with this problem. However, these strategies require significant investment of staff time and resources. Given the scarcity of healthcare resources, investment should be balanced against the health and economic benefits achieved. Future research evaluating the cost-effectiveness of such programs is needed to identify ways of tackling this problem that represent value for money.

References

1. Wong J, Khu K, Kaderali Z, Bernstein M. Delays in the operating room: signs of an imperfect system *Can J Surg*. 2010; **53**:189–95.

2. Schofield W, Rubin G, Piza M, Lai Y, Sindhusake D, Fearnside M, et al. Cancellation of operations on the day of intended surgery at a major Australian referral hospital. *Med J Aust*. 2005; **182**:612-5.

3. Queensland Health. *Surgical Instrument Management Clinical Practice Review Report*. Brisbane: Queensland Health; 2008.

4. Harders M, Malangoni M, Weight S, Sidhu T. Improving operating room efficiency through process redesign. *Surgery*. 2006; **140**:509–14.